Dentistry

ملاحظة :-

الحل شرح وهم وشرحه الدكتور محمد بأقلام التظليل للتسهيل فقط !*

((المحاضرة الأولى))

وجدانيه عبد الخالق العزي

1- Bacterial Morphology

ملاحظات :-

1. في الفم توجد الجراثيم وتقدر بـ (10^{10}).
2. في الأمعاء تقدر بـ (10^{16}).
3. في الجلد تقدر بـ (10^{6}) في أماكن التعرق.

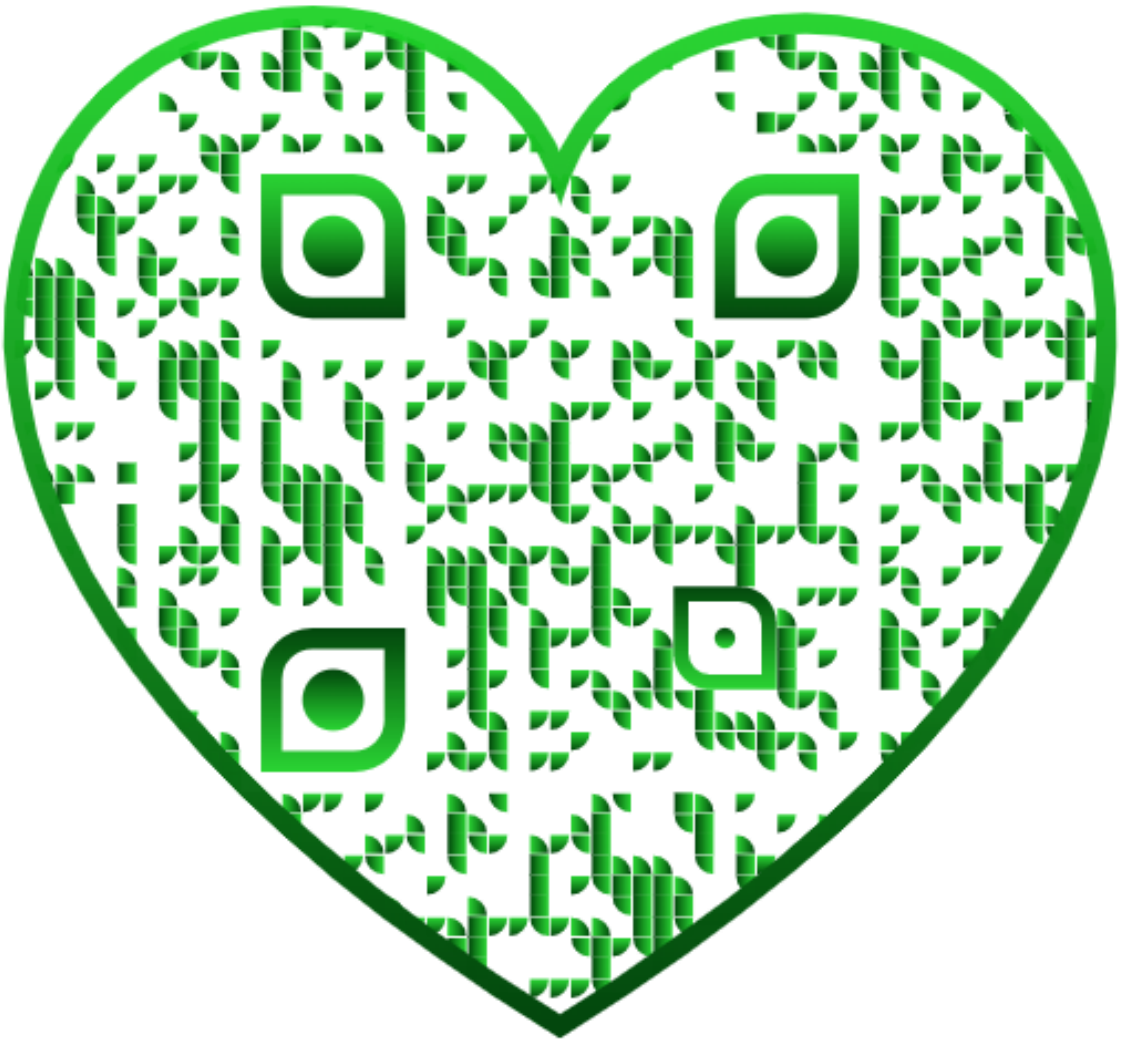
أول نوع من البكتريا ينمو في فم الأطفال هو (StreptoCocci).

Bacterial Morphology

تفيدنا معرفة أشكال البكتريا في تشخيص الأمراض

- **According to microscopic examination:**

1) **Cocci** (Spherical), كروي
2) **Bacillus** (Rod shaped), عصوية
3) **Spirillum** (Spirals), حلزونية
4) **Polymorph** متعددة الأشكال (واوية)



Bacterial

1- Spherical (Cocci- coccus)

1- Aggregations- clusters (Grape like)

- Irregular clusters of cocci

e.g. *Staphylococci*

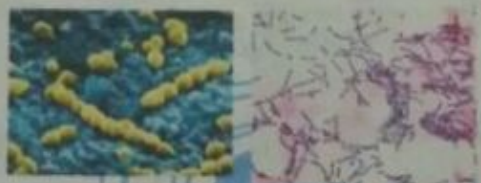
2- Diplocooci

- Pairs of cocci

e.g. *Streptococci pneumonia*

3- Chains of cocci

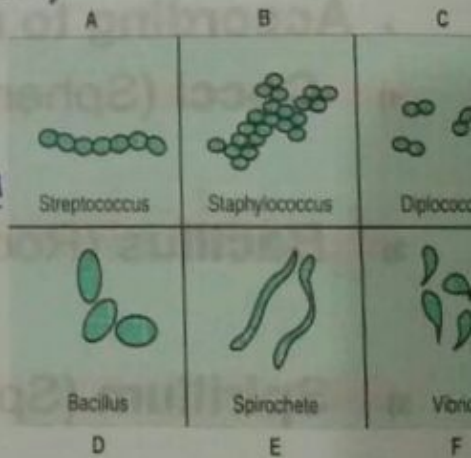
Strept.pyogens



Bacterial Morphology

2- Rod like (Bacilli- bacillus)

- Rod like
- *Diplo bacilli*
  - Pairs of bacilli
- *Strept. bacilli*
  - Chains of bacilli



3- Spirochetes

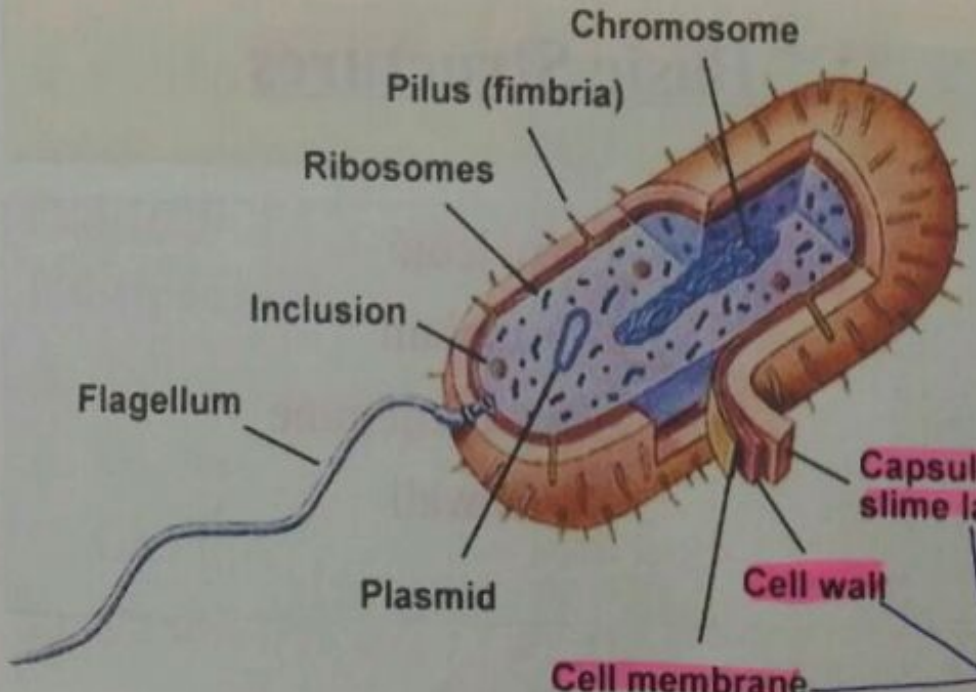
- Spiral

e.g. *T.pallidium*

4- Polymorph: (*V. cholera*)

2- Bacterial Cell Structure

Bacterial Cell Structures



Bacterial Structures

- **Basic structures:** ← في كل أنواع البكتريا توجد
  - Nucleoid, Cytoplasm, Cell membrane , Cell wall.
- **Special structures:** تراكيب معرضة في بعض أنواع البكتريا
  - Flagella , Pili, Capsule, Endospore.

Basic Structures

1-Nucleoid

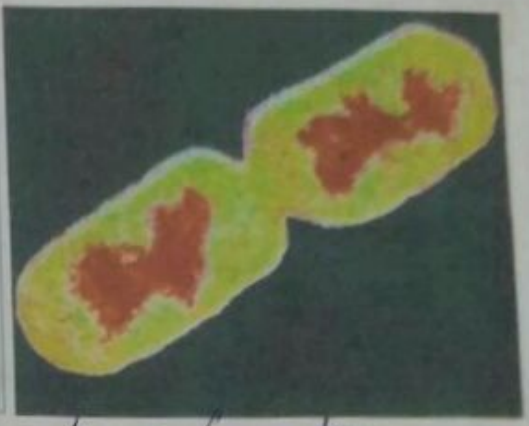
2-Cytoplam

3-Cell membrane

4-Cell wall

1-Nucleoid

- Circular, double-stranded DNA.
- It is not compartmentalized by membrane.



*Function: Carrier Genatic information.

E. coli: 4,639 kb, contains 3,000 ~ 5,000 genes

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2-Cytoplasm

It consists of 80% Water (20% Salts-Proteins).

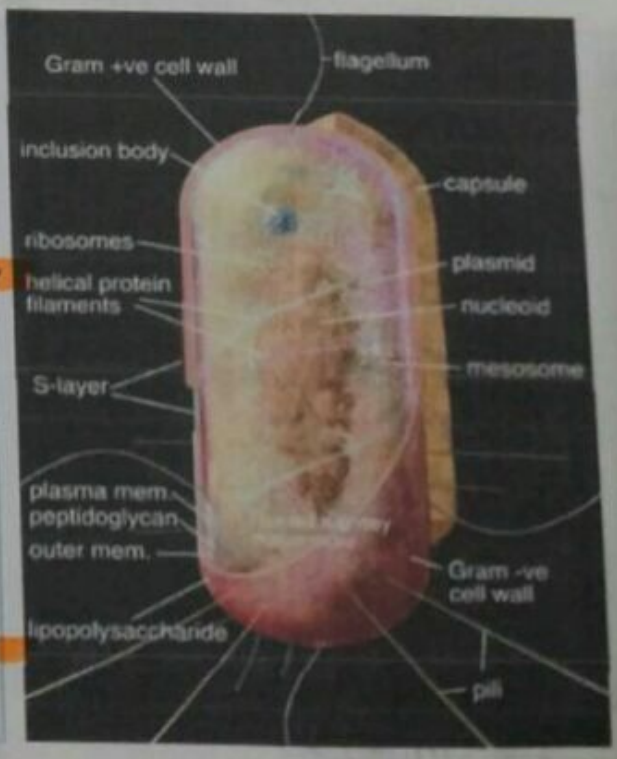
It includes: ← مكونات بسيطة

A. Ribosome → Formation protiens.

B. Plasmid

C. Granules

D. Mesosome ← كانه قريب من النواة وله دور في الانقسام



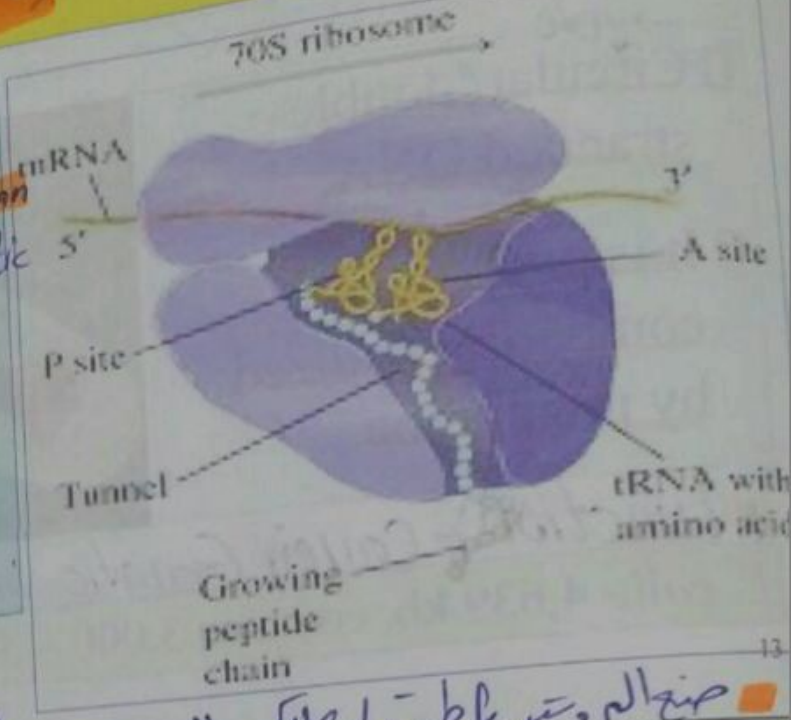
A) Ribosome

- 70S, Two subunits:
  - 50S 50s
  - 30S 40s
- Bacteria prykaryotic
- in human eukaryotic
- Smaller than eukaryotic ribosome

Ribosome has two supunit

50s large subunit

30s small subunit



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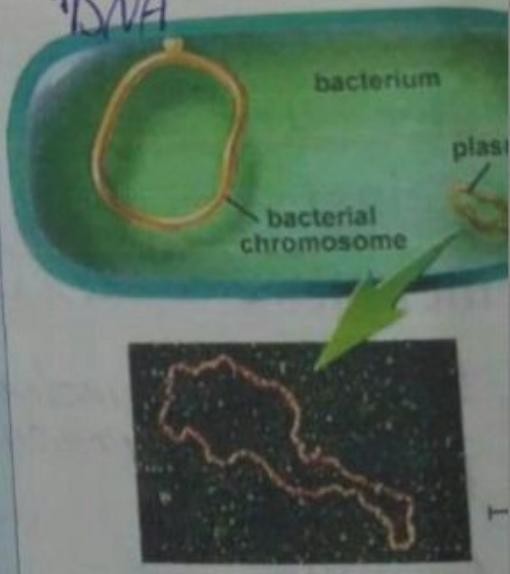
صنع البروتين يحتاج مكونات الكود والشفرة (mRNA / tRNA) وارتباط.

B) Bacterial Plasmid

DNA موجود في النواة لكنه يتركب من DNA

- Extra-chromosomal DNA.
- Coding **pathogenesis** and **antibiotic resistance factors**.
- Bacterial replication independently..



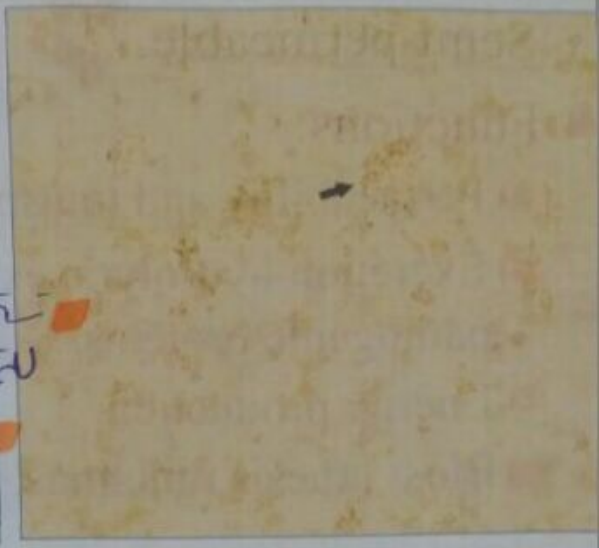
DNA موجود في النواة

plasmid

الجينات الخاصة بالبكتيريا (exo bacterial) في الـ (plasmid)

C) Cytoplasmic Granules

- Nutrients
- Metachromatic granule:
  - Basic
  - Differential value
    - e.g. *Corynebacterium diphthriae*

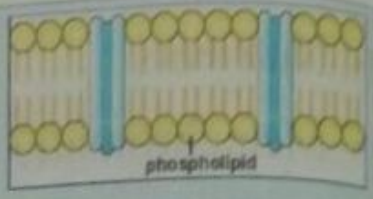


D) Mesosome

- Mitochondria-like organelle in bacteria.
  - Energy synthesis.
- Folded by cell membrane.
- **Gram positive cells**.
- Work as spindle apparatus.

3) Cell Membrane

- Semi-permeable. نفاذي
- Functions:
  - Permeability and transport.
  - Excretion hydrolytic exo-enzymes and pathogenic proteins.
  - Energy production.
  - Biosynthesis functions.



* إذا تمزق cell. membr تموت الخلية البكتيرية.

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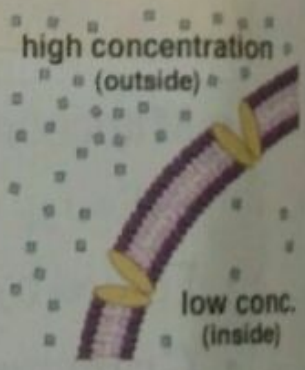
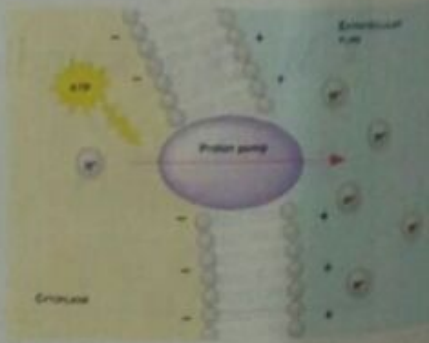
Transport Across the Cell Membrane

- **Basic rule**: things spontaneously move from high concentration to low concentration (downhill). This process is called **diffusion**.
  - Getting many molecules into the cell is simply a matter of opening up a protein channel of the proper size and shape. The molecules then move into the cell by diffusing down the concentration gradient. **Passive transport**, or **facilitated diffusion**.



- To get things to move from low to high (uphill), you need to add energy: the molecules must be pumped into the cell. Pumps are driven by ATP energy. **Active transport**.



4) Cell Wall

➢ **Functions:**

- Maintain the shape of bacterium.
- Rigid, protecting cell from osmotic lysis.
- Exchange nutrients and chemicals.
- Antigenicity.
- Relate to its pathogenesis.

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4) Cell Wall

➢ **Structure:**

Peptidoglycan

Similarities and differences between the Gram + / - cell walls.

4) Cell Wall

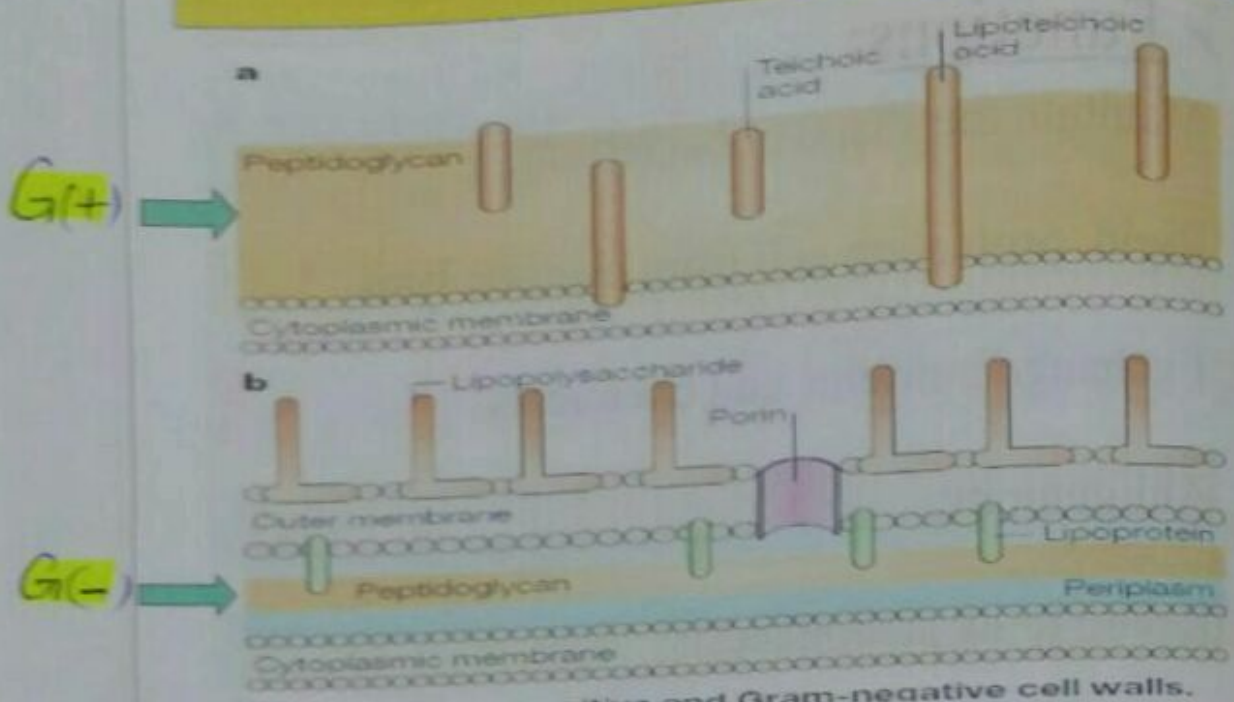
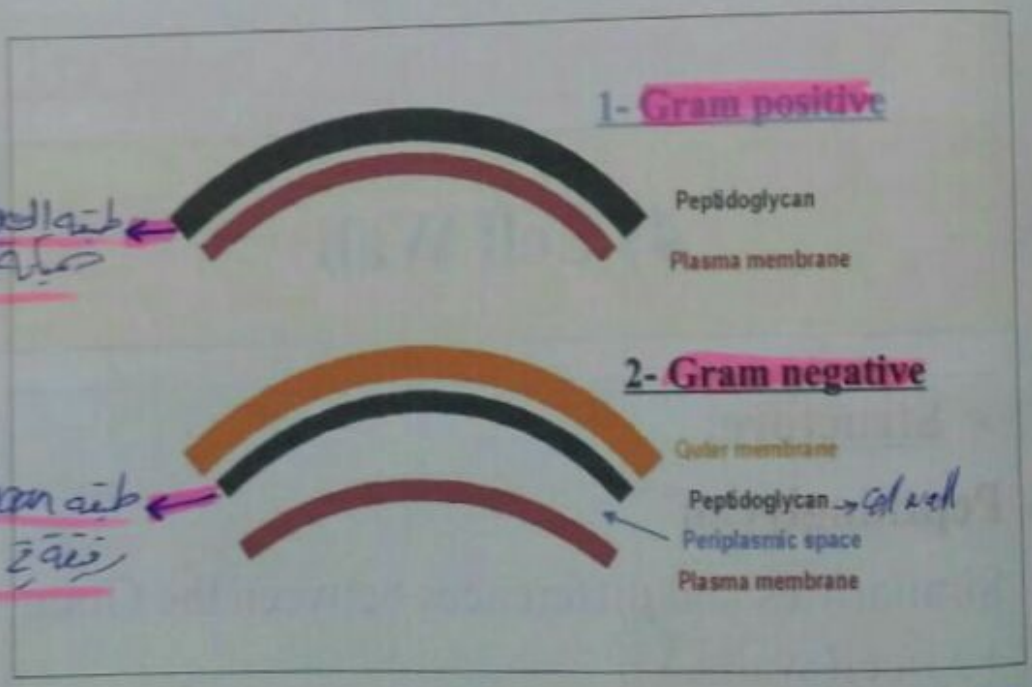


Figure 2 | **Gram-positive and Gram-negative cell walls.**



Comparison of G+ / G- cell walls

tructure of (gram + & gram -) ⟹ peptidoglycan or (murein)

① peptidoglycan same meaning to ② muriens

Bacterial Cell Wall structure

➤ Peptidoglycan:

- Single macromolecule.
- Highly cross-linked.
- Surrounds cell.
- Provides rigidity.

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Gram (+)

① thick layer or polylayer.
② Teichoic acid & lipoteichoid acid.
③ Teichoic & lipoteichoic
④ exo-toxic
⑤ not has outer membrane

peptidoglycan

➤ Peptidoglycan = Murein

Meroids

- **Glycan backbone:**
  - **Muramic acid.**
  - **Glucosamine.**
- **Peptide side chain**
- **Peptide cross-bridge**
  - **D- and L- amino acids**
  - **diaminopimelic acid**

Murein

Gram (-)

① Thin layer or unilayer.
② teichoic & lipo
③ not stain
④ has lipopolysaccharide
⑤ Has periplasmic space
⑥ outer membrane

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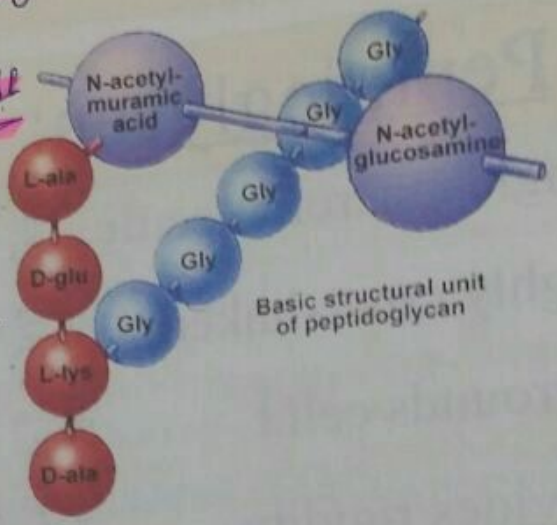
Peptidoglycan

* structure of peptidoglycans:

N-acetyl nuramic acid
N-acetyl glucosamine



Basic structural unit of peptidoglycan

① D & L amino acids
② diamino pimelic acid.

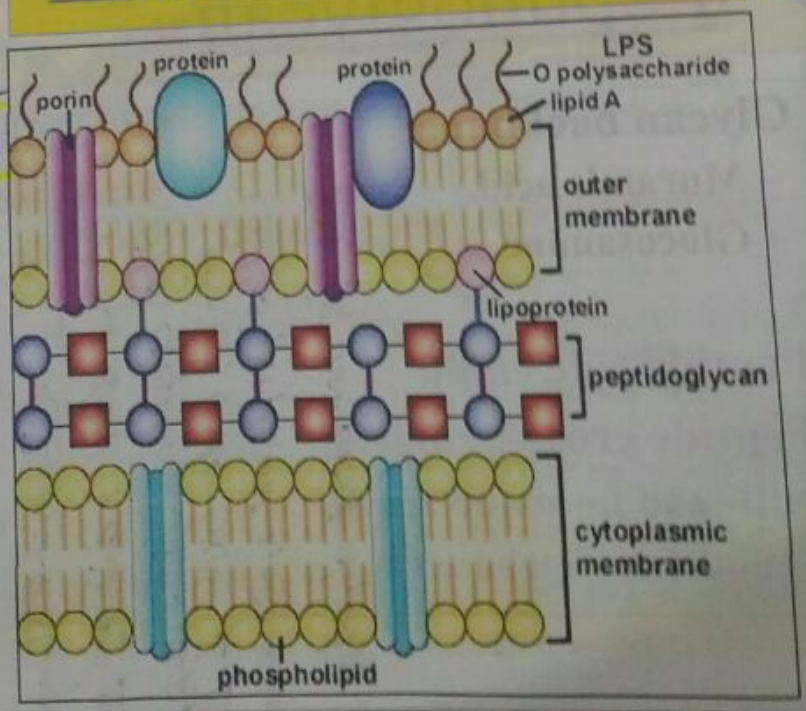
(amino acid)

* Acid fast: المركب الذي يدخل في cell membrane & cell wall

↓ lipoteichoic acid

↓

Gram Negative Cell Wall



Gram Negative Cell Wall

Outer Membrane

- Lipopolysaccharide (LPS)
  - Endotoxin
- Phospholipids.
- Proteins.
  - porins

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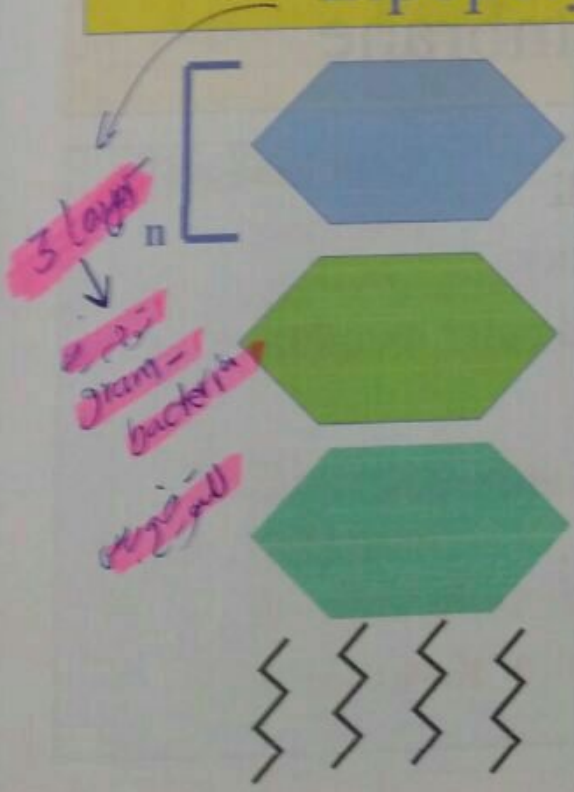
Lipopolysaccharide



O-antigen
- **Highly variable**

Core
- **Heptoses**
- **Ketodeoxyoctonic acid**

Lipid A
- **Glucosamine disaccharide**
- **Beta hydroxy fatty acids**

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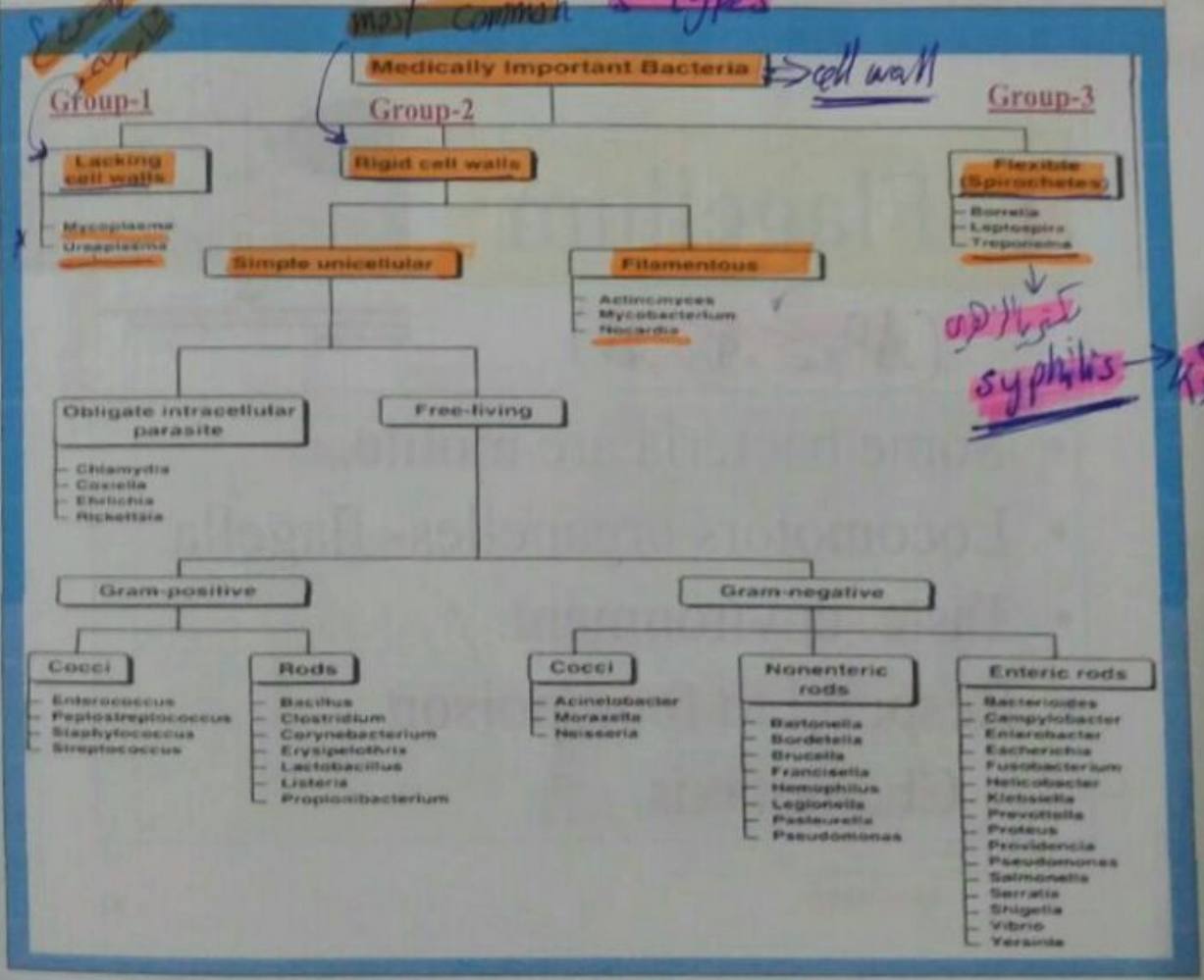
classification of bacteria according to staining in to two types

Gram + Gram -

Medically important Bacteria can be classified according to cell wall into 3 groups:

* بعض أنواع البكتيريا (G+ or G-) عندها (outer membrane) وعندها (outer membrane) وهذا يعطيها resistance للجراثيم.

classification of bacteria according to cell wall into 3 types



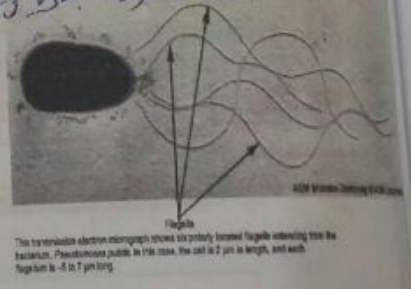
Special Structures

1-Flagellum ← سوط
2-Pili
3-Capsule
4-Endospore

(تقدم محاضرة واحدة وجلدت)

1- Flagellum

(عضو حركة وتجميع المواد)



This transmission electron micrograph shows six polarly located flagella extending from the bacterium, *Pseudomonas putida*. In this case, the cell is 2 µm in length, and each flagellum is ~5 to 7 µm long.

- Some bacteria are motile.
- Locomotors organelles- flagella.
- Taste environment.
- Respond to food/poison
- Chemotaxis.

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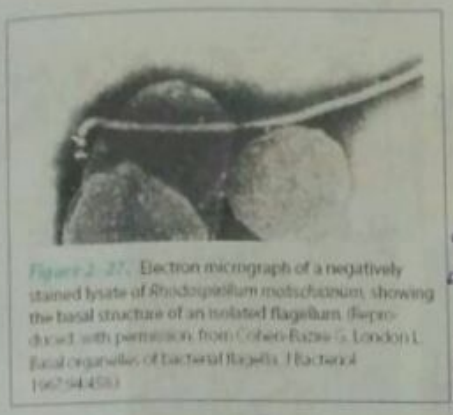
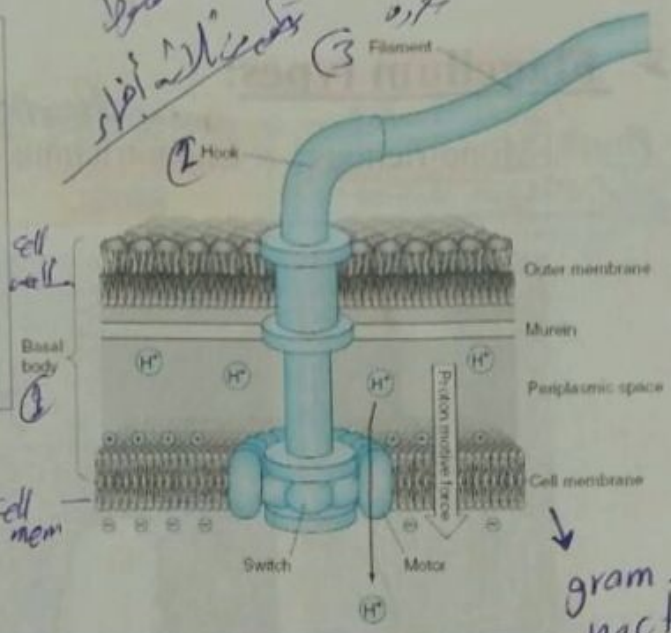


Figure 2-27. Electron micrograph of a negatively stained lysate of *Rhodospirillum molischianum*, showing the basal structure of an isolated flagellum. (Reproduced with permission from Cohen-Bazire G, London J. Basal organelles of bacterial flagella. J Bacteriol 1967;94:458.)



2 ring pair

cell mem

gram – bacteria

➢ **Structure:**

- Embedded in cell membrane.
- Project as strand.
- Flagellin (protein) subunits.
- Move cell by propeller like action.

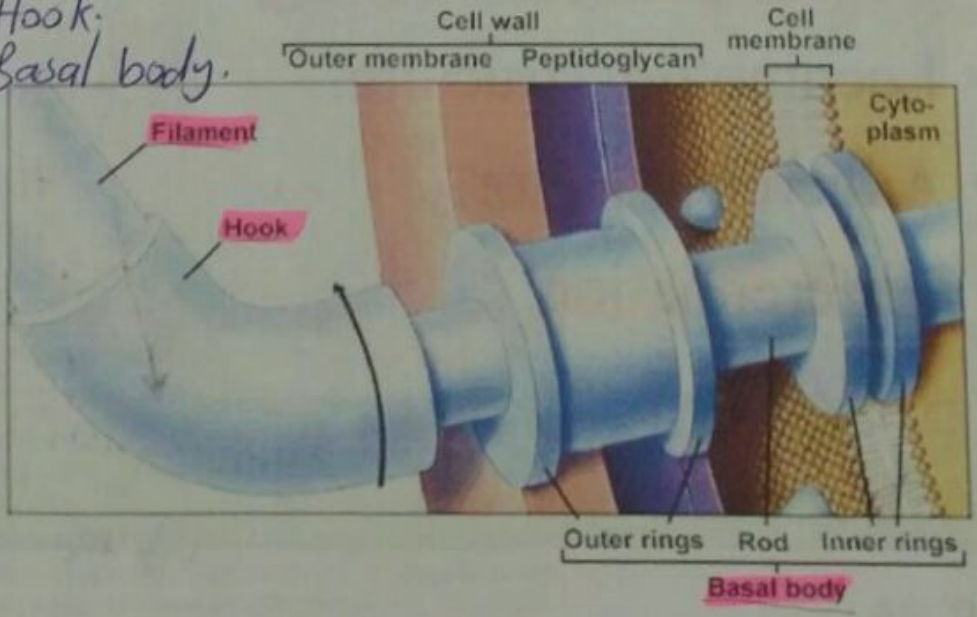
(1) Gram (–) consist of (2 pair)
(2) Gram (+) consist of (one pair)

gram
1 ring ← +

1- Flagellum

➢ **Structure:**

(1) Filament.
(2) Hook.
(3) Basal body.



Flagellum types:

one flagella in one polar

Monotrichous	Lophotrichous	Peritrichous
Vibrio cholerae	Spirilla	E. coli

many flagella

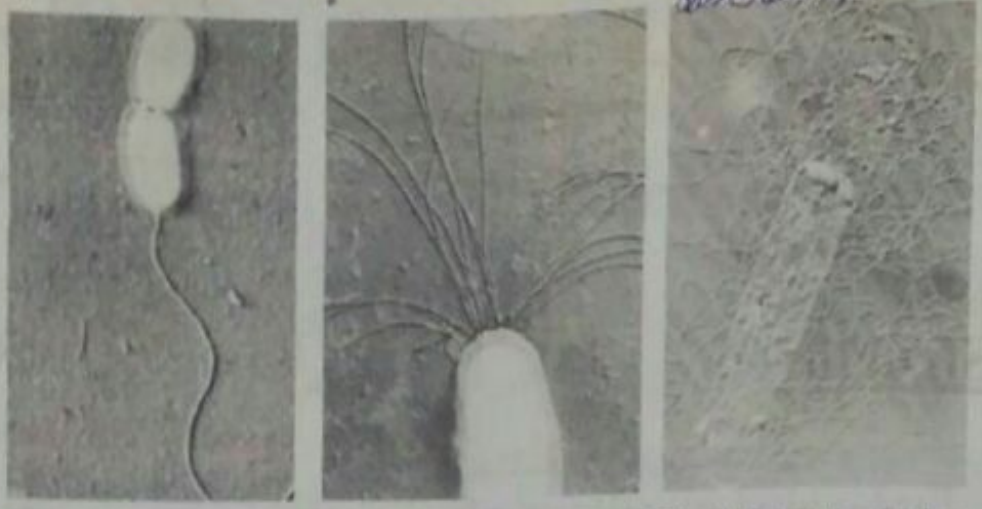


Figure 2–2b Bacterial flagellation. A: *Vibrio metchnikovii*, a monotrichous bacterium (7500 ×). (Courtesy of van Iterson W. Biochim Biophys Acta 1947;1:527.) B: Electron micrograph of *Spirillum serpens*, showing lophotrichous flagellation (9000 ×). (Courtesy of van Iterson W. Biochim Biophys Acta 1947;1:527.) C: Electron micrograph of *Proteus vulgaris*, showing peritrichous flagellation (9000 ×). Note basal granules. (Courtesy of Houwink A. van Iterson W. Biochim Biophys Acta 1950;5:10.)

* تنظهر مع H2O ← الشخص بكونه مصاب بالتيفوئيد.
* H-Ag ← تتكون من Flagellum.
* O-Ag ← من جدار الخلية Cell wall.
* K-Ag ← من Capsule أو Vi ← تظهر مع K بكونه الشخص حامل للمرض.

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Functions of Flagellum

- Motor substance
- Protein, antigenic (H.Ag).
- Locomotory strucutre.
- Adherence factor.→
- Differentiation.

O & H ←

Cell wall ← O

H

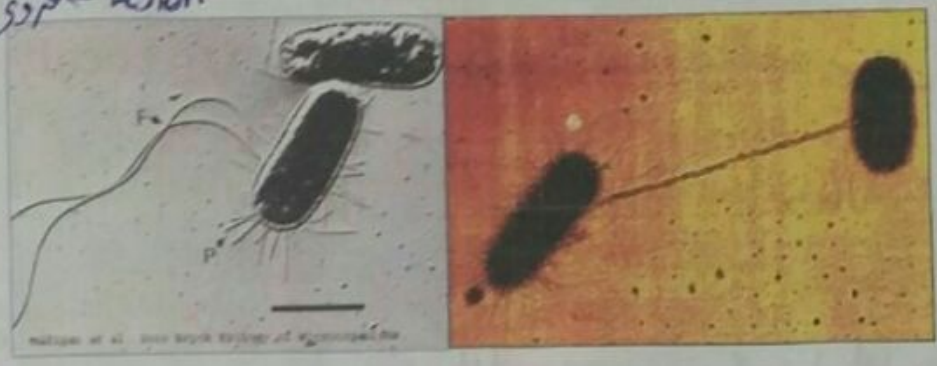
A

Bi

Capsule

2) Pili (fimbriae, Pilus)

- Hair-like projections of the cell.
- Sexual conjugation.
- Adhesion to host epithelium.



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➢ **Pilus types:**

Figure 2-30. Surface appendages of bacteria. Electron micrograph of a cell of *E coli* possessing three types of appendages: ordinary pili (short, straight bristles), a sex pilus (longer, flexible, with phage particles attached), and several flagella (longest, thickest). Diameters: ordinary pili: 7 nm; sex pili: 8.5 nm; flagella: 25 nm. (Courtesy of J Carnahan and C Brinton.)

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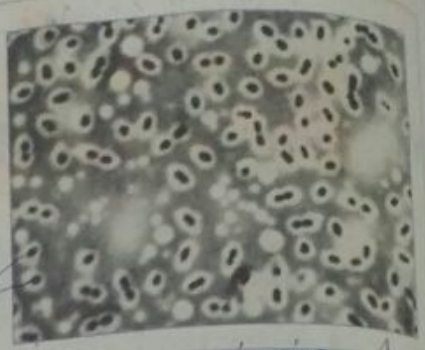
3) Capsules & Slime Layers



- Outside cell envelope.
  - well defined: Capsule.
  - not defined: slime layer or Glycocalyx.
- Usually polysaccharide.
- Often lost on *in vitro* culture.
- Protective *in vivo*.

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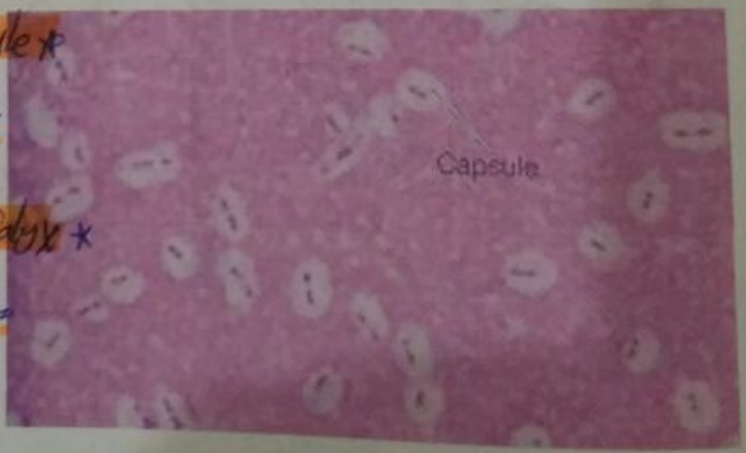
(in vivo)

Special Stains

Capsule Stain



Klebsiella pneumoniae

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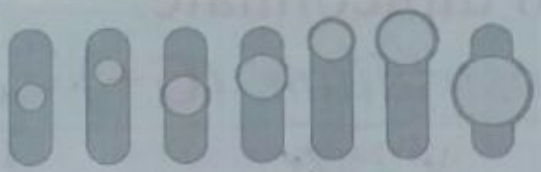
هنالك نوعين من الجراثيم نوع (positive) تكون بواغ فقط:-
1 Bacillus.
2 clostridium ⇒ lock jaw تسبب انغلاق الفك

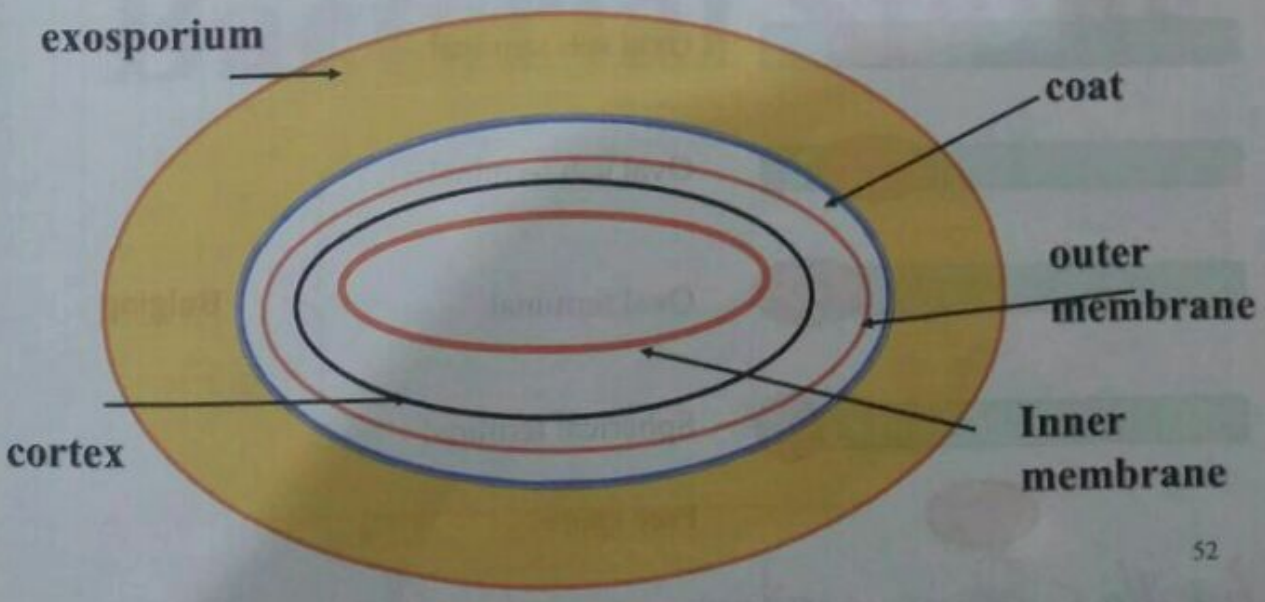
4) Endospores (Spores)
أنواع



كلوستريديم باستيلاي يصاب فيه فيروس يهاجم البكتريا يعني داخل الجرثومة تعاود للحياة

The endospore Structure

gram + bact عليه تحسس الفيروس



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تكون الأبواغ في حالتين:-
1) لما توفر الظروف البيئية المناسبة لنمو البكتيريا وتعيش داخل جدار وقاوم الحرارة وتظل أشهر السنين
2) توجد بكثرة في مخلفات الحيوانات.

4) Endospores (Spores)

- Dormant cell.
- Produced when starved.
- Resistant to adverse conditions.
  - high temperatures.
  - organic solvents.
- Contain calcium dipicolinate.
- *Bacillus* and *Clostridium*. (G+) stack جام

معظم وجود في التراب

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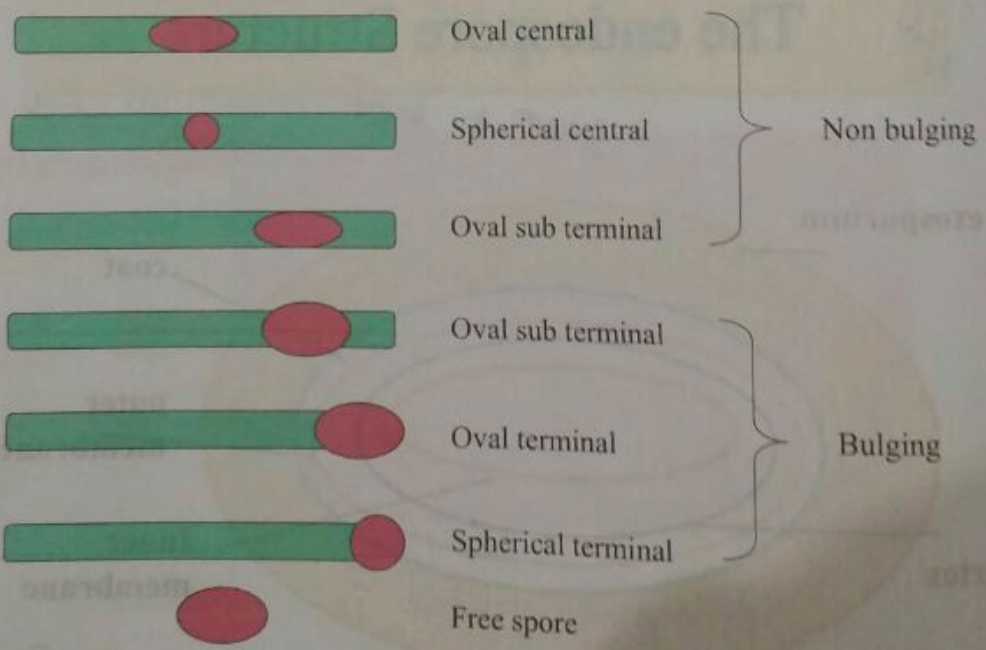
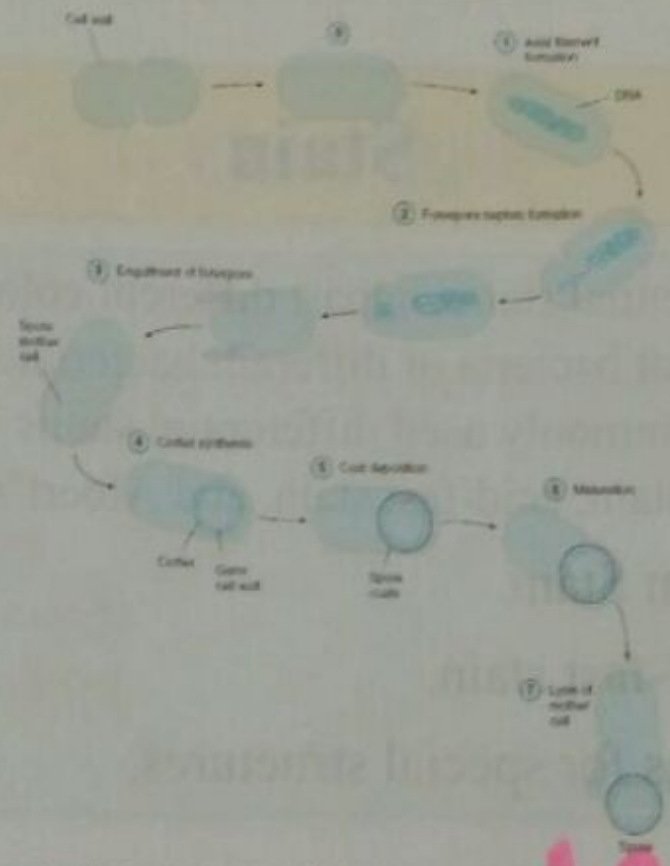
Shape & position of bacterial spore:



① Bacillus cereus vomiting

②



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Bacterial Stains

vertical tran

horizontal transport

donor

respon

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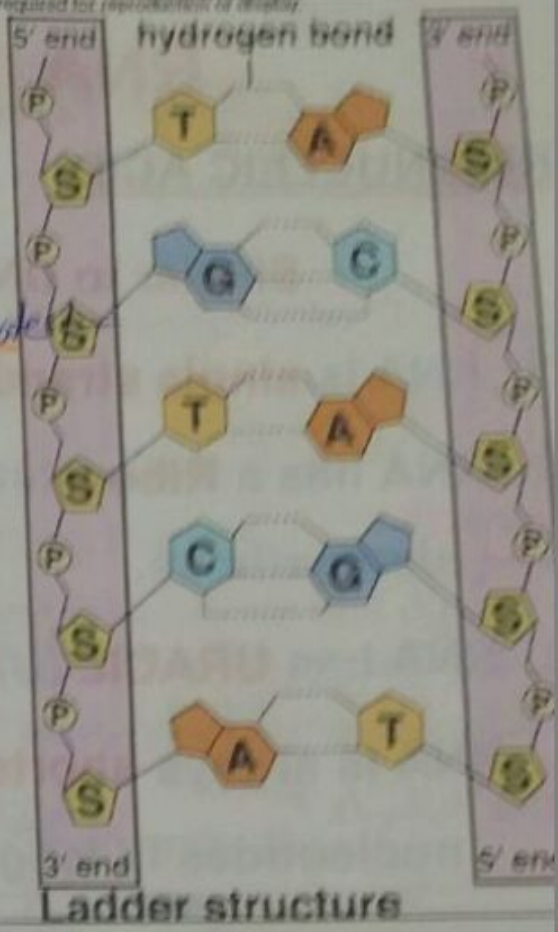
Overview of DNA structure (2)

(DNA) Replication in prokaryotes

1. Initiation = بداية
2. Elongation = الاستطالة
3. Termination = نهاية (التوقف)



Ladder structure

DNA Structure

- DNA is a **double helix** (there are 2 strands of DNA) which are intertwined with 5 base pairs per turn.
- DNA has **Complimentarity**

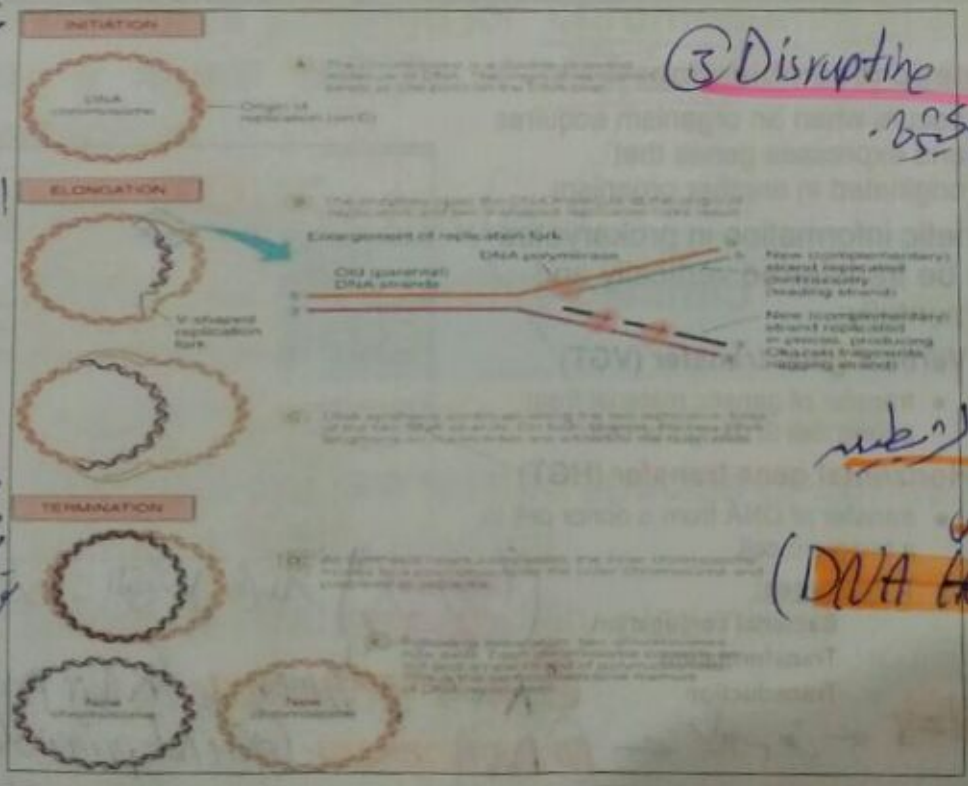
  that is A always bonds with T

  and G always with C
- DNA is always **antiparallel.** The 2 strands of DNA are always oriented in opposite directions. (5' PO_3 end – 3' OH end).

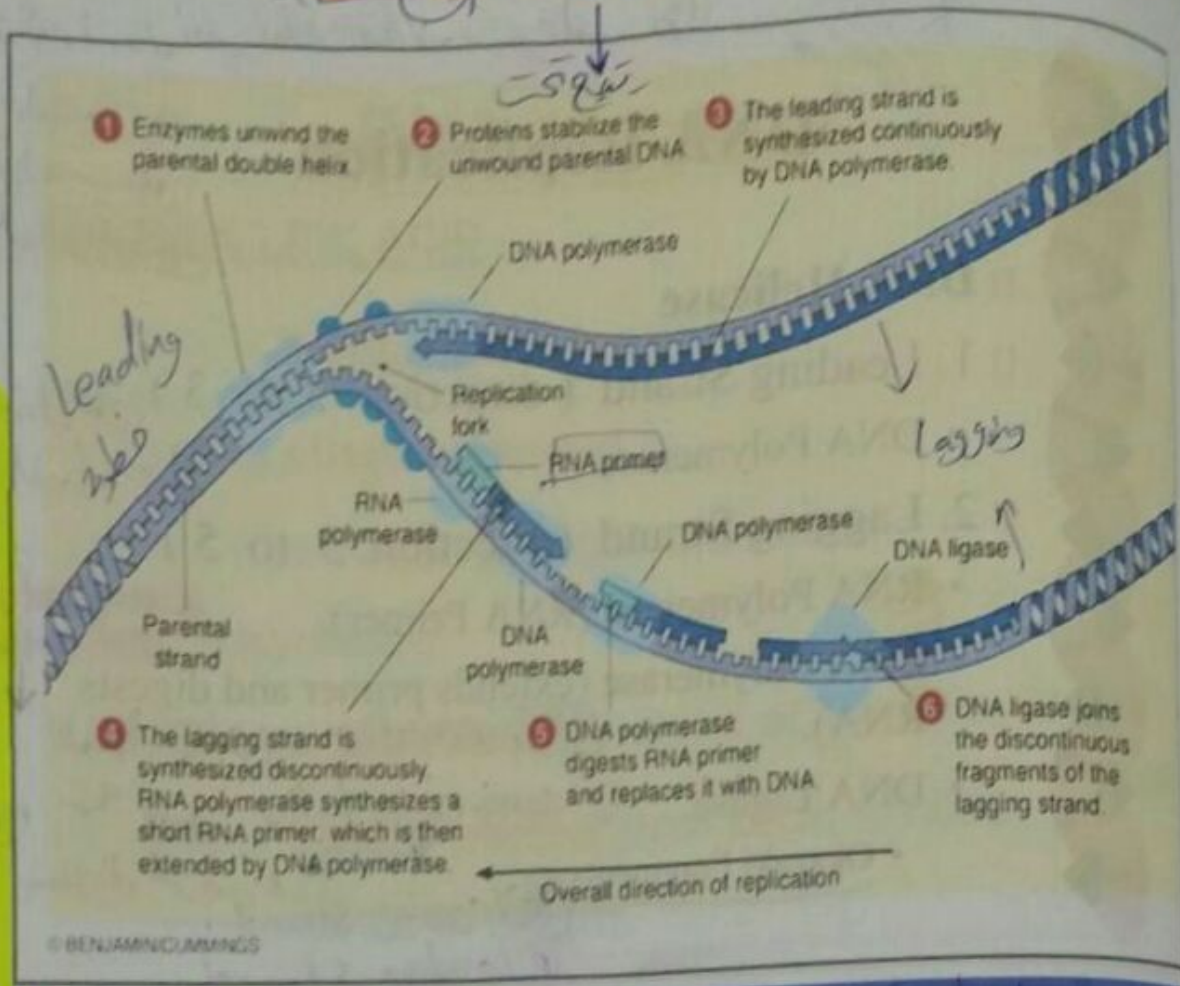
DNA Replication

- DNA Helicase
- 1. Leading Strand (direction: 5 to 3)
  - DNA Polymerase.
- 2. Lagging Strand (direction: 3 to 5)
  - RNA Polymerase (RNA Primer).
  - DNA Polymerase (extends primer and digests RNA).
  - DNA Ligase.
  - Okazaki Fragments

DNA Replication in Prokaryotes



الإنزيم الذي يعمل على التكاثر (leading) DNA polymerase يكون متصل (3 إلى 5) في خطوة واحدة


1 Enzymes unwind the parental double helix
2 Proteins stabilize the unwound parental DNA
3 The leading strand is synthesized continuously by DNA polymerase
DNA polymerase
leading
Replication fork
RNA primer
RNA polymerase
DNA polymerase
DNA ligase
lagging
Parental strand
DNA polymerase
4 The lagging strand is synthesized discontinuously RNA polymerase synthesizes a short RNA primer, which is then extended by DNA polymerase
5 DNA polymerase digests RNA primer and replaces it with DNA
6 DNA ligase joins the discontinuous fragments of the lagging strand
Overall direction of replication
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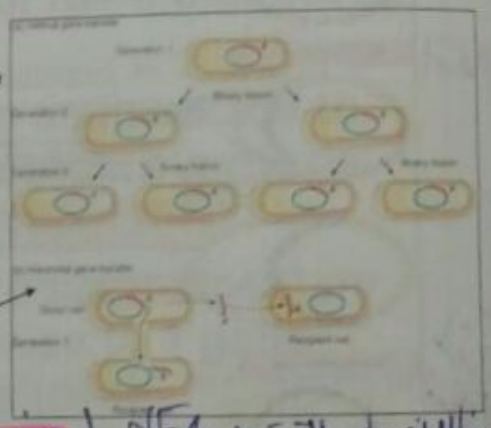
(primer) على شكل قطعة صغيرة

Genetic Recombination in Prokaryotes

- **Genetic recombination:**
  - occurs when an organism acquires and expresses genes that originated in another organism.
- Genetic information in prokaryotes can be transferred vertically and horizontally:
  - **Vertical gene transfer (VGT)**
    - transfer of genetic material from parent cell to daughter cell
  - **Horizontal gene transfer (HGT)**
    - transfer of DNA from a donor cell to a recipient cell.
    - **Three types:**
      - Bacterial conjugation
      - Transformation
      - Transduction



(lagging strand) هما الإنزيمات التي تعمل على تكاثر

② DNA polymerase (RNA primer)

② DNA ~ (extends primer digests RNA)

③ DNA ligase يقوم بإزالة قطعة الـ RNA primer

(Okazaki Fragment) يقوم بإزالة قطعة الـ RNA primer